

Updated distribution records of the *Anopheles (Anopheles) hyrcanus* species-group (Diptera: Culicidae) in China

LEOPOLDO M. RUEDA^{1,2,7}, TONGYAN ZHAO³, YAJUN MA⁴, QI GAO⁵, ZHU GUO DING⁵,
 BENJAWAN KHUNTRAT⁶, JETSUMON SATTABONGKOT⁶ & RICHARD C. WILKERSON¹

¹Walter Reed Biosystematics Unit, Department of Entomology, Walter Reed Army Institute of Research, Silver Spring, MD 20910, USA

²Walter Reed Biosystematics Unit, Museum Support Center, MRC 534, Smithsonian Institution, 4210 Silver Hill Road, Suitland, MD 20746 USA. E-mail: ruedapol@si.edu

³Beijing Institute of Microbiology and Epidemiology, State Key Laboratory of Pathogen and Biosecurity, 2004 DAV00214, Beijing 100071, P.R. China

⁴Department of Etiologic Biology, Second Military Medical University, 800 Xiangyin Road, Shanghai 200433, P.R. China

⁵Jiangsu Institute of Parasitic Diseases, Meiyuan, Wuxi, Jiangsu 214064, P.R. China

⁶Department of Entomology, USAMC-AFRIMS, Bangkok 10400, Thailand

⁷Corresponding author

Abstract

Mosquito collections were carried out during July–August 2005 in China. The known distribution of *Anopheles hyrcanus* species-group in China is updated based on published records and original observations. Twenty-one of about 30 known species of the Old World Hyrcanus group (*Anopheles* subgenus *Anopheles*), including *An. belenrae* Rueda, were recorded in 24 provinces and 2 cities. *Anopheles sinensis* Wiedemann, recorded in 21 provinces and 2 cities, is the most widely distributed species, followed by *An. pullus* Yamada and *An. kweiyangensis* Yao and Wu. The status of the type specimens of some Hyrcanus group species and their importance in disease transmission are also noted.

Key words: *Anopheles*, Hyrcanus group, Diptera, Culicidae, mosquitoes, malaria, China

Introduction

The Old World *Anopheles hyrcanus* group consists of about 30 species (Harbach 2004, Ramsdale 2001). The group contains about three quarters of the species belonging to the Myzorhynchus Series of the genus *Anopheles* subgenus *Anopheles* (Harbach 2004, Rueda 2005). Some species of this group are vectors of malarial parasites and other mosquito-borne diseases in the Oriental and Palearctic regions, in particular *An. sinensis* Wiedemann and *An. lesteri* Baisas and Hu in China and the Republic of Korea (Tanaka *et al.* 1979, Lu *et al.* 1997, Rueda *et al.* 2006).

In China, there are 21 known species of the Hyrcanus group: *An. argyropus* (Swellengrebel), *belenrae* Rueda, *changfus* Ma*, *crawfordi* Reid, *dazhaius* Ma*, *hailarensis* Xu and Luo*, *heiheensis* Ma*, *hyrcanus* (Pallas), *junlianensis* Lei*, *kiangsensis* Xu and Feng*, *kunmingensis* Dong and Wang*, *kweiyangensis* Yao and Wu*, *lesteri* (junior synonym = *anthropophagus* Xu and Feng), *liangshanensis* Kang, Tan and Cao*, *nigerrimus* Giles, *nitidus* Harrison, Scanlon and Reid, *peditaeniatus* (Leicester), *pullus* Yamada, *sinensis**, *sineroides* Yamada, and *xiaokuanus* Ma*. The type localities of 11 species (with asterisks above) are in China (<http://www.mosquitocatalog.org/main.asp>).

Distribution records for Hyrcanus group in China are incomplete or unavailable, particularly data for specimens deposited in various museums. Rueda *et al.* (2005a) reported on the distribution of *An. sinensis* based on specimens deposited in the Chinese Academy of Science museum, Beijing, and on published

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records. Ma & Yu (1993) listed 15 species of the group in their records from China, while Lu and Yong (2003) included 8 species from several provinces. We conducted this study to determine the distribution of *Hyrcanus* group species in China based on museum specimens, published reports, and our field collections.

Material and methods

Field collections. Our 26 mosquito collections in China during July and August 2005 resulted in 247 individually reared pinned adults, 118 individually reared adults preserved in 100% ethyl alcohol for molecular tests (204 of those reared adults with exuviae of larvae and pupae), and 109 whole larvae. Larval and pupal skins were slide mounted using standard protocols (Walter Reed Biosystematics Unit 2001). Concurrently, two type localities and two sites near type localities were sampled for mosquitoes in 2005, i.e. Kunming, Yunnan for *An. kunmingensis*; Guiyang, Guizhou for *An. kweiyangensis*; Jiangsu for *An. kiangsuensis*; and Sichuan for *An. liangshanensis*. We initially targeted larval collections from habitats where *Anopheles* were likely to occur, such as rice paddies, vegetable fields, irrigation ditches, roadside and drainage ditches, stream margins and pools, ground or drain pools, ponds, and others. Larvae and pupae were collected using dippers and then reared individually to the adult stage (Walter Reed Biosystematics Unit 2001). Adult *Anopheles* were collected by mouth aspirators in rural villages using mesh-screened mosquito nets (182 x 122 x 122 cm), with light attractant outside the net, and indoors and outdoors from dwelling walls. Voucher specimens are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.

Museum specimens. Specimens of *Hyrcanus* group species deposited at three institutions were examined, namely Institute of Zoology Museum (Chinese Academy of Science, Beijing), Entomology Museum (Institute of Microbiology and Epidemiology, Beijing) and Entomology Collection Laboratory (Department of Etiologic Biology, Second Military Medical University, Shanghai). Coordinates for collection sites of museum specimens were recorded using gazetteers of the U. S. Board of Geographic Names (1979) and the Global Gazetteer (2006).

Mosquito identifications. Adult specimens and associated larval/pupal exuviae of both field-collected and museum specimens were identified using morphological characters in Tanaka *et al.* (1979), Ma & Yu (1993) and Lu *et al.* 1997, and some field-collected specimens were confirmed using an rDNA ITS2-based method (Wilkerson *et al.* 2003).

Results and discussion

The distribution of the *Hyrcanus* group in China is shown in Figure 1. Twenty-one species of the group were found in 24 provinces and 2 cities (Beijing and Shanghai), with Yunnan having the highest number of species (7), followed by Liaoning (6) and Sichuan (6), and the remaining provinces with 1–4 species (Tables 1 and 2). *Anopheles sinensis*, the most widespread species of the group in China, was recorded from 21 provinces and 2 cities. *Anopheles lesteri* (=*anthropophagus*, Ma 1981), the second most widespread species, was found in 15 provinces, followed by *An. pullus* (12 provinces) and *An. kweiyangensis* (11 provinces). Other species are recorded from 1–5 provinces.

Although *An. sinensis* is considered an important vector of malaria in China, particularly in rice producing areas (Lu *et al.* 1997), it is considered about 20 times less susceptible than *An. lesteri* (as *An. anthropophagus*) (Liu *et al.* 1990). *Anopheles sinensis* is common in rice fields, ditches (irrigation/roadside/drainage), stream pools, stream margins, road tracks, and other habitats (Tanaka *et al.* 1979, Lu & Yong 2003, Rueda *et al.* 2006). During our survey, we collected the larvae and pupae of *An. sinensis* from small creeks, rice paddies, irrigation ditches, irrigated sugar cane and vegetable fields (primarily corn, string beans, soybeans and crucifers), ground pools, and permanent ponds. In 2005, the mean water temperature (27.4°C), conductivity (0.54 uS) and salinity (0.35 ppm) of larval/pupal habitats in rice paddies were greater than in the surrounding irriga-

tion ditches (25.1°C , 0.16 uS, and 0.33 ppm, respectively); however, the mean pH (7.35, 7.33) in both habitats was essentially equal. In the irrigation ditches of vegetable fields, mean temperature, conductivity, salinity and pH were 28.2°C , 0.72 uS, 0.35 ppm and pH 7.4, respectively.

Anopheles lesteri (as *An. anthropophagus*), the primary vector of malaria in China, is susceptible to infections of both *Plasmodium vivax* and *P. falciparum* (Lu *et al.* 1997). In addition to being an important vector of filarial worm, *Brugia malayi*, in China, it can be artificially infected with *Wuchereria bancrofti* in the laboratory (Lu *et al.* 1997).

Other potential vectors of malaria in China include *An. kunmingensis* and *An. hyrcanus* (Lu *et al.* 1997). *Anopheles pullus* is not known as a malaria vector in China, unlike in South Korea (Shin *et al.* 2002, Hong 1977). *Anopheles pullus*, *An. liangshanensis* and *An. kweiyangensis* are potential vectors of filariasis in various parts of China, with the first 2 species a major threat in Sichuan Province (Lu *et al.* 1997).

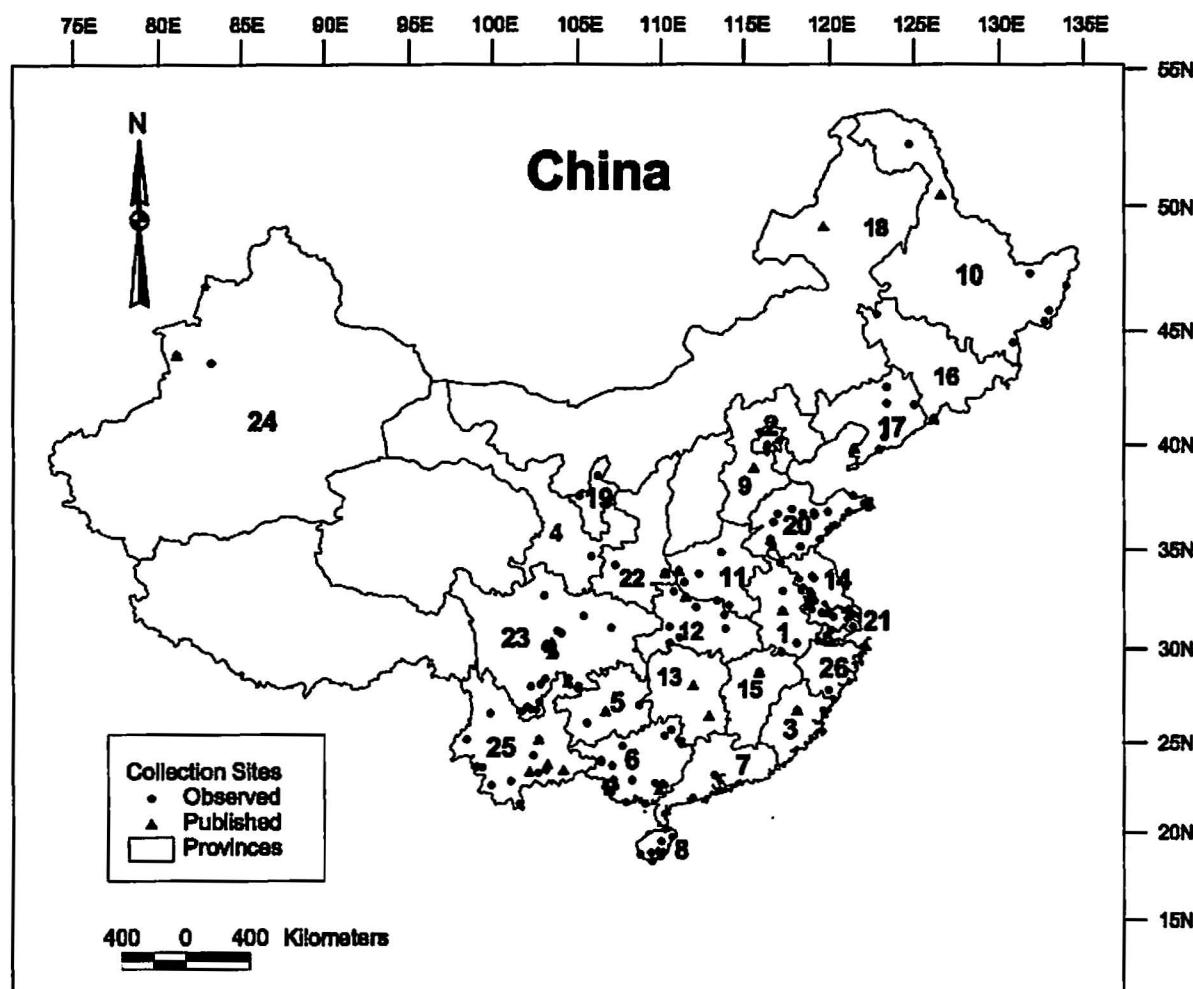


FIGURE 1. Map of mainland China showing the distribution of *Anopheles hyrcanus* group (based on observed and published specimens). Province Identification: (1) Anhui, (2) Beijing (3) Fujian, (4) Gansu, (5) Guandong, (6) Guangxi, (7) Guizhou, (8) Hainan, (9) Hebei, (10) Heilongjiang, (11) Henan, (12) Hubei, (13) Hunan, (14) Jiangsu, (15) Jiangxi, (16) Jilin, (17) Liaoning, (18) Inner Mongol, (19) Ningxia, (20) Shandong, (21) Shanghai, (22) Shaanxi, (23) Sichuan, (24) Xinjiang, (25) Yunnan, (26) Zhejiang.

TABLE 1. Summary of collection localities for *Anopheles* Hyrcanus Group species (based on observed specimens) in China.

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | Repository ³ |
|----------------------|--|--|-------------------------------|-------------------------------|-----------|--------|---|-------------------------|
| | | | | Latitude | Longitude | W | | |
| <i>belenrae</i> | Liaoning: Donggang | Aug 1998 | D | 39.77 | N | 121.50 | W | SM |
| <i>belenrae</i> | Shandong: Jining | Jul 1997; Aug 2000 | D | 35.41 | N | 116.58 | W | SM |
| <i>crawfordi</i> | Yunnan: Mengla | Nov 1998 | 1F | 21.47 | N | 101.58 | W | SM |
| <i>dazhaius</i> | Sichuan: Chengdu | 18 Jun 1982 | 20L | 30.67 | N | 104.07 | W | IM |
| <i>hyrcanus</i> | Xinjiang: Yili | Aug 1957 | 1F | 43.52 | N | 83.30 | W | IM |
| <i>hyrcanus</i> | Xinjiang: Yining | Jul 1999 | D | 43.88 | N | 81.25 | W | SM |
| <i>hyrcanus</i> | Xinjiang: Yining | 1995 | 2F, 1M | 43.88 | N | 81.25 | W | SM |
| <i>junlianensis</i> | Sichuan: Hongya | Aug 1997 | D | 29.93 | N | 103.42 | W | SM |
| <i>junlianensis</i> | Sichuan: Pujiang | Sep 1994 | D | 30.20 | N | 103.50 | W | SM |
| <i>kunmingensis</i> | Sichuan: Chengdu | 16 Jan 1989 | 3F | 30.67 | N | 104.07 | W | SM |
| <i>kunmingensis</i> | Yunnan: Longling | Feb 1989 | 2L, 1P | 24.58 | N | 98.68 | W | SM |
| <i>kunmingensis</i> | Yunnan: Tengchong | Dec 1981; 1989; Aug 1997 | 9F, 2M; 4L | 25.03 | N | 98.47 | W | IM |
| <i>kweiyangensis</i> | Guizhou: Guanling | Sep 1994 | 3F, 1M | 25.95 | N | 105.63 | W | SM |
| <i>kweiyangensis</i> | Guizhou: Guiyang | Aug 1988; 1961 | 1L, 1P; 1F, 1M | 26.92 | N | 108.73 | W | SM |
| <i>kweiyangensis</i> | Henan: Xinyang | 8 Jul 1973; 1973; 30 Jul 1978 | 2F; 4L; 1M | 32.10 | N | 114.12 | W | IM |
| <i>kweiyangensis</i> | Liaoning: Xiuyan | 24-25 Jul 1958 | 2F | 40.29 | N | 123.27 | W | IM |
| <i>kweiyangensis</i> | Sichuan: Leshan | May 1956 | 2F | 29.57 | N | 103.73 | W | IM |
| <i>kweiyangensis</i> | Sichuan: Pujiang | 1 Sep 1994; Apr 1997 | 4F | 30.20 | N | 103.50 | W | SM |
| <i>kweiyangensis</i> | Sichuan: Yaan | 31 Jul; 2-3 Aug 1975 | 3M; 1M, 4F | 29.98 | N | 103.08 | W | IM |
| <i>kweiyangensis</i> | Zhejiang: Zhoushan | 30 May, 8 Jun, 2 July, 1953; 25 Aug, 14 Sep 1953 | 4F; 1M | 30.02 | N | 122.10 | W | IM |
| <i>lesteri</i> | Guangdong: Guang- zhou | 1 Jan, Nov 2003 | 10F | 23.12 | N | 113.25 | W | SM |
| <i>lesteri</i> | Guangdong: Zhuhai | Jul 2002 | 1F | 22.28 | N | 113.57 | W | SM |
| <i>lesteri</i> | Guangdong: Hen- qing Island, Zhuhai | Nov 2004 | 4F | 22.28 | N | 113.57 | W | FC |
| <i>lesteri</i> | Guangxi: Bobai | No date | 1F | 22.28 | N | 109.97 | W | SM |
| <i>lesteri</i> | Hainan: Wenchang | No date | 1F | 19.62 | N | 110.75 | W | SM |
| <i>lesteri</i> | Henan: Tanghe | Jul 1999 | 1F | 33.85 | N | 111.12 | W | SM |
| <i>lesteri</i> | Henan: Tongbai | Jul 1999 | 1F | 32.36 | N | 113.40 | W | SM |
| <i>lesteri</i> | Henan: Xinyang | Jul 1999 | 1F | 32.10 | N | 114.12 | W | SM |
| <i>lesteri</i> | Jiangsu: Huai'an | Nov 2004 | 3F | 33.50 | N | 119.14 | W | FC |
| <i>lesteri</i> | Jiangsu: Wuxi | 14, 16 May 1987 | 47F, 50M | 31.58 | N | 120.29 | W | IM |
| <i>lesteri</i> | Liaoning: Donggang | Aug 1997 | D | 39.77 | N | 121.50 | W | SM |

to be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|-----------------------|---|-------------------------------|-------------------------------|-------------------------------|-----------|--------|---|----|-------------------------|
| | | | | Latitude | Longitude | | | | |
| <i>lesteri</i> | Liaoning: Faku | Sep 1996 | D | 42.50 | N | 123.41 | W | SM | |
| <i>lesteri</i> | Liaoning: Shenyang | Aug 1998 | D | 41.79 | N | 123.43 | W | SM | |
| <i>lesteri</i> | Liaoning: Zhuanghe | Aug 1999 | D | 39.70 | N | 122.99 | W | SM | |
| <i>lesteri</i> | Yunnan: Weixin | Aug 1999 | D | 27.80 | N | 105.08 | W | SM | |
| <i>liangshanensis</i> | Sichuan: Chengdu | 2 Jun 1982 | 1Ge | 30.67 | N | 104.07 | W | IM | |
| <i>liangshanensis</i> | Sichuan: Chengdu | 1 Jan 1989 | 3F, 1M, 2L | 30.67 | N | 104.07 | W | SM | |
| <i>liangshanensis</i> | Sichuan: Chengdu | No date | 7F, 3M | 30.67 | N | 104.07 | W | IM | |
| <i>liangshanensis</i> | Sichuan: Chengdu | 28 Apr 1982 | 3L, 3Pe, 2Ge | 30.67 | N | 104.07 | W | IM | |
| <i>liangshanensis</i> | Sichuan: Zhaojiao Co., Yuan, Liangshan | 1 Jun 1997 | 4F | 27.90 | N | 102.27 | W | SM | |
| <i>liangshanensis</i> | Sichuan: Zhaojue | Jun 1997 | D | 28.02 | N | 102.85 | W | SM | |
| <i>liangshanensis</i> | Yunnan: Tengchong | Aug 1997 | 1F | 25.03 | N | 98.47 | W | IM | |
| <i>nigerrimus</i> | Yunnan: Kunming | No date | 3F, 1M | 25.04 | N | 102.72 | W | IM | |
| <i>peditaeniatus</i> | Fujian: Nanping | 25 Aug 1959 | 1F | 26.65 | N | 118.17 | W | IM | |
| <i>peditaeniatus</i> | Guangxi: Daxin | 1 Oct 1957 | 1F | 22.84 | N | 107.20 | W | IM | |
| <i>peditaeniatus</i> | Guangxi: Longzhou | 13 Sep 1974 | 1F | 22.35 | N | 106.86 | W | IM | |
| <i>peditaeniatus</i> | Guangxi: Mobian | 20 Jun 1967 | 1F | 22.45 | N | 107.31 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Diaoluoshan | 7 Apr 1974 | 1F | 18.80 | N | 109.88 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Qiongzhou | 12 Jul 1974 | 1F | 20.06 | N | 110.35 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Tunchang | 12 Sep 1956 | 8F | 19.36 | N | 110.10 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Wenchang | 9 Sep 1956 | 3F | 19.62 | N | 110.75 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Wenhua, Haikou | 7 Jun 1974 | 1F | 20.05 | N | 110.34 | W | IM | |
| <i>peditaeniatus</i> | Hainan: Xinglong | 12 Sep 1956 | 2F | 18.75 | N | 110.20 | W | IM | |
| <i>peditaeniatus</i> | Yunnan: Gengma | 2 Jul 1954 | 1F | 23.52 | N | 99.40 | W | IM | |
| <i>peditaeniatus</i> | Yunnan: Mengding | 27 Jul 1953 | 2F | 23.55 | N | 99.08 | W | IM | |
| <i>peditaeniatus</i> | Yunnan: Mengla | 27 Jul 1953; Aug 2001 | 1F | 21.47 | N | 101.58 | W | IM | |
| <i>peditaeniatus</i> | Yunnan: Shuangjiang | 15 Jul 1953; 2 Jul 1954 | 1F; 7F | 24.17 | N | 102.40 | W | IM | |
| <i>pullus</i> | Guizhou: Ergezhai, Guiyang | 12 Aug 2005 | 1M, 1L | 26.58 | N | 106.72 | W | FC | |
| <i>pullus</i> | Heilongjiang: Hurao | Jul, Aug 1961; 18 Sep 1980 | 3F | 45.77 | N | 132.99 | W | IM | |
| <i>pullus</i> | Heilongjiang: Raohe | 24 Jul 1992 | 1F | 46.80 | N | 134.02 | W | IM | |
| <i>pullus</i> | Heilongjiang: Suib- ing | 14 Aug 1971 | 1F | 47.29 | N | 131.86 | W | IM | |
| <i>pullus</i> | Heilongjiang: Suiy- ang | 6 Aug 1971 | 1F | 44.43 | N | 130.88 | W | IM | |

To be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|----------------------|---------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------|--------|---|----|-------------------------|
| | | | | Latitude | Longitude | | | | |
| <i>pullus</i> | Heilongjiang: Xing-kaihu | 8, 13 Jun, 12, 17 Jul 1971 | 4F | 45.30 | N | 132.77 | W | IM | |
| <i>pullus</i> | Henan: Tanghe | Jul 2001 | 1F | 33.85 | N | 111.12 | W | SM | |
| <i>pullus</i> | Liaoning: Donggang | Aug 1997 | D | 39.77 | N | 121.50 | W | SM | |
| <i>pullus</i> | Liaoning: Shenyang | Aug 1998 | D | 41.79 | N | 123.43 | W | SM | |
| <i>pullus</i> | Liaoning: Xinbin | 14 Jul 1991 | 1F | 41.72 | N | 125.04 | W | IM | |
| <i>pullus</i> | Shandong: Jining Co. | 25 Jul 2005 | 3F, 1M | 35.41 | N | 116.58 | W | SM | |
| <i>pullus</i> | Sichuan: Gaoxian | No date | D | 28.35 | N | 104.52 | W | SM | |
| <i>pullus</i> | Sichuan: Junlian | No date | D | 28.13 | N | 104.48 | W | SM | |
| <i>pullus</i> | Sichuan: Pujiang | Sep 2004 | 4F | 30.20 | N | 103.50 | W | SM | |
| <i>sinensis</i> | Anhui: Fucunniufang | 12 Jul 1989 | 3 F | 29.73 | N | 117.24 | W | CA | |
| <i>sinensis</i> | Anhui: Furen | 12 Jul 1989 | 3 F | 31.85 | N | 117.28 | W | CA | |
| <i>sinensis</i> | Anhui: Furenfang | 8 Jul 1989 | 1 F | 32.85 | N | 117.28 | W | CA | |
| <i>sinensis</i> | Anhui: Huangshan | 25 Jun 1989 | 1 F | 30.17 | N | 118.12 | W | CA | |
| <i>sinensis</i> | Anhui: Shuifutian | 12 Jul 1989 | 2 F | 32.68 | N | 118.98 | W | CA | |
| <i>sinensis</i> | Beijing: Beijing | 4-28 June 1957 | 135 F | 39.93 | N | 116.39 | W | CA | |
| <i>sinensis</i> | Beijing: Daxing | 12-14 Aug 1970 | 12 F | 39.72 | N | 116.33 | W | CA | |
| <i>sinensis</i> | Beijing: Pinggu | 24 Jun 1974 | 12 F, 1 M | 40.13 | N | 117.12 | W | CA | |
| <i>sinensis</i> | Beijing: Yianqing | 25 Jun 1974 | 13 F, 1 M | 40.47 | N | 115.97 | W | CA | |
| <i>sinensis</i> | Fujian: Nanping | No date | 1F | 26.65 | N | 118.17 | W | CA | |
| <i>sinensis</i> | Gansu: Tianshui | 14, 18 Jun 1972 | 3F | 34.58 | N | 105.89 | W | SM | |
| <i>sinensis</i> | Gansu: Tianshui | 26-27 Jul 1972 | 4F | 34.58 | N | 105.89 | W | SM | |
| <i>sinensis</i> | Guangdong: Daling | No date | 1F | 39.72 | N | 116.33 | W | CA | |
| <i>sinensis</i> | Guangdong: Guangzhou | 30 Sep 1961 | 1 F | 23.12 | N | 113.25 | W | CA | |
| <i>sinensis</i> | Guangdong: Guangzhou, Yangjiang | Jun 1956 | 2F | 23.12 | N | 113.25 | W | IM | |
| <i>sinensis</i> | Guangdong: Zhuhai | No date | 1F | 22.28 | N | 113.57 | W | CA | |
| <i>sinensis</i> | Guangxi: Baise | 1 Jul 1957 | 1F | 23.82 | N | 106.45 | W | IM | |
| <i>sinensis</i> | Guangxi: Beihai | 12 Aug 1974 | 1F | 21.48 | N | 109.10 | W | IM | |
| <i>sinensis</i> | Guangxi: Bobai | 13 Sep 1957 | 1F | 22.28 | N | 109.97 | W | IM | |
| <i>sinensis</i> | Guangxi: Daxin | Oct 1957 | 4F | 22.84 | N | 107.20 | W | IM | |
| <i>sinensis</i> | Guangxi: Dongxing | 5 May, 7, 16 Aug 1974 | 4F | 21.55 | N | 107.97 | W | IM | |
| <i>sinensis</i> | Guangxi: Fuying | 22 Jun 1957 | 1F | 24.83 | N | 111.27 | W | IM | |
| <i>sinensis</i> | Guangxi: Guilin | 29 Jun, 8, 29 Jul, 25 Aug 1967 | 4F | 25.28 | N | 110.28 | W | IM | |
| <i>sinensis</i> | Guangxi: Longrui | 6 Dec 1990 | 2 F | 22.22 | N | 107.07 | W | CA | |
| <i>sinensis</i> | Guangxi: Longzhou | 11 Sep 1974 | 1F | 22.35 | N | 106.86 | W | IM | |
| <i>sinensis</i> | Guangxi: Mobian | 14 May, 9 Jun 1957 | 11F; 1M | 22.45 | N | 107.31 | W | IM | |
| <i>sinensis</i> | Guangxi: Munan | 13 Jul 1957 | 1F | 21.98 | N | 106.72 | W | IM | |

To be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|----------------------|----------------------------|--|-------------------------------|-------------------------------|-----------|--------|----|----|-------------------------|
| | | | | Latitude | Longitude | W | IM | | |
| <i>sinensis</i> | Guangxi: Nanning | Dec 1956 | 1F | 22.82 | N | 108.32 | W | IM | |
| <i>sinensis</i> | Guangxi: Ningming | 14 Jun 1957; 4 Sep 1974 | 2F | 22.13 | N | 107.07 | W | IM | |
| <i>sinensis</i> | Guangxi: Pingguo | 1 Sep 1957 | 1F | 23.91 | N | 106.46 | W | IM | |
| <i>sinensis</i> | Guangxi: Pingle | Oct 1959 | 2F | 22.54 | N | 110.27 | W | IM | |
| <i>sinensis</i> | Guangxi: Pingxiang | 25-30 Apr, 20 May, 1 Jul 1957; 29 Aug 1974 | 4F; 2M | 22.66 | N | 106.76 | W | IM | |
| <i>sinensis</i> | Guangxi: Pingxiang | 5, 11 Dec 1986 | 4 F | 22.66 | N | 106.76 | W | CA | |
| <i>sinensis</i> | Guangxi: Tiandong | 14 Jun, 7 Sep 1957 | 2F, 1M | 23.61 | N | 107.12 | W | IM | |
| <i>sinensis</i> | Guangxi: Xiakou | Oct 1957 | 1F | 24.68 | N | 107.73 | W | IM | |
| <i>sinensis</i> | Guangxi: Xingan | 13 Sep 1957 | 1F | 25.62 | N | 110.67 | W | IM | |
| <i>sinensis</i> | Guangxi: Yulin | 16, 20 Sep 1957 | 2F | 22.63 | N | 110.15 | W | IM | |
| <i>sinensis</i> | Guizhou: Ergezhai, Guiyang | 12 Aug 2005 | 11F, 12M, 1L | 26.58 | N | 106.72 | W | FC | |
| <i>sinensis</i> | Guizhou: Guiyang | Jun 1955 | 3F | 26.92 | N | 108.73 | W | IM | |
| <i>sinensis</i> | Hainan: Dengmai | No date | 1F | 18.70 | N | 109.45 | W | CA | |
| <i>sinensis</i> | Hainan: Lingshui | No date | 1F | 18.52 | N | 110.02 | W | CA | |
| <i>sinensis</i> | Hainan: Ya | No date | 1F | 18.23 | N | 109.48 | W | CA | |
| <i>sinensis</i> | Hainan: Yulin | Nov 1981 | 4F | 18.23 | N | 109.53 | W | SM | |
| <i>sinensis</i> | Heilongjiang: Raohe | 3, 4, 24 Jul 1982 | 2F, 1M | 46.80 | N | 134.02 | W | IM | |
| <i>sinensis</i> | Heilongjiang: Tahe | 2 Aug 1975 | 1 F | 52.33 | N | 124.73 | W | CA | |
| <i>sinensis</i> | Henan: Funiu | 17 Sep 1990 | 9 F | 33.70 | N | 112.30 | W | CA | |
| <i>sinensis</i> | Henan: Tanghe | Jul 2001 | 1F | 33.85 | N | 111.12 | W | SM | |
| <i>sinensis</i> | Henan: Tongbai | 10 - 13 Aug 1973; Jul 2001 | 5F, 1M | 32.36 | N | 113.40 | W | IM | |
| <i>sinensis</i> | Henan: Xinyang | 21-28 Jun 1973 | 3F, 7M | 32.10 | N | 114.12 | W | IM | |
| <i>sinensis</i> | Henan: Xiaxia | 6 Aug 1973 | 1F | 33.29 | N | 111.47 | W | IM | |
| <i>sinensis</i> | Henan: Zhengzhou | No date | 1F | 34.76 | N | 113.65 | W | CA | |
| <i>sinensis</i> | Hubei: Changyang | 21 Sep 1957 | 3F | 30.47 | N | 111.19 | W | IM | |
| <i>sinensis</i> | Hubei: Junxian | 1957 | 5F | 32.54 | N | 111.51 | W | IM | |
| <i>sinensis</i> | Hubei: Wufeng | 1957 | 1F | 30.20 | N | 110.60 | W | IM | |
| <i>sinensis</i> | Hubei: Xiangyang | 18 Jun 1957 | 2F, 1M | 32.04 | N | 112.15 | W | IM | |
| <i>sinensis</i> | Hubei: Xiaogan | 1957 | 6F | 30.92 | N | 113.90 | W | IM | |
| <i>sinensis</i> | Hubei: Yinshan | 1957 | 5F | 31.62 | N | 113.82 | W | IM | |
| <i>sinensis</i> | Hubei: Yunxian | 1957 | 11F | 32.81 | N | 110.81 | W | IM | |
| <i>sinensis</i> | Hubei: Zigui | 1957 | 6F | 31.02 | N | 110.58 | W | IM | |
| <i>sinensis</i> | Jiangsu: Huai'an | Nov 2004 | 3F | 33.50 | N | 119.14 | W | FC | |
| <i>sinensis</i> | Jiangsu: Huaiyin | 19 Jul 1970 | 2F | 33.59 | N | 119.02 | W | IM | |
| <i>sinensis</i> | Jiangsu: Jiajiang | 5 Aug 1975 | 2F | 31.45 | N | 121.09 | W | IM | |
| <i>sinensis</i> | Jiangsu: Jintan | 19 Jul 1970 | 2F | 31.75 | N | 119.58 | W | IM | |

To be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|----------------------|--------------------------------------|--------------------------|-------------------------------|-------------------------------|-----------|--------|---|----|-------------------------|
| | | | | Latitude | Longitude | W | S | | |
| <i>sinensis</i> | Jiangsu: Nanjing | No date | 1F | 32.06 | N | 118.78 | W | SM | |
| <i>sinensis</i> | Jiangsu: Nanjing, Liuhe | 29 Jul 2005 | 1M, 3L | 32.06 | N | 118.78 | W | FC | |
| <i>sinensis</i> | Jiangsu: Nanjing, Maji | 29 Jul 2005 | 30F | 32.06 | N | 118.78 | W | FC | |
| <i>sinensis</i> | Jiangsu: Sinho, Sihong | 19 July 1970 | 3F | 33.46 | N | 118.21 | W | IM | |
| <i>sinensis</i> | Jiangsu: Sinho, Sihong | 27 Jul 2005 | 5F, 5M, 1L | 33.46 | N | 118.21 | W | FC | |
| <i>sinensis</i> | Jiangsu: Sinho, Tiam Gan Hu | 27 Jul 2005 | 33 F | 33.46 | N | 118.21 | W | FC | |
| <i>sinensis</i> | Jiangsu: Suzhou | 19 Jul 1970 | 9F | 31.93 | N | 118.98 | W | IM | |
| <i>sinensis</i> | Jiangsu: Wujing | Jul 1997 | 1F | 31.78 | N | 119.97 | W | SM | |
| <i>sinensis</i> | Jiangsu: Wujing | No date | 1F | 31.78 | N | 119.97 | W | CA | |
| <i>sinensis</i> | Jiangsu: Wuxi | 31 Jul 2005 | 7F, 13M, 12P, 14L, 2LE | 31.58 | N | 120.29 | W | FC | |
| <i>sinensis</i> | Jiangsu: Wuxi | No date | 1F | 31.58 | N | 120.29 | W | CA | |
| <i>sinensis</i> | Jiangsu: Xinhailian | 19 Jul 1970 | 3F | 31.92 | N | 121.17 | W | IM | |
| <i>sinensis</i> | Jiangsu: Xuyi Co., Quiji | 28 Jul 2005 | 5F, 12M, 10P, 10L | 33.01 | N | 118.49 | W | FC | |
| <i>sinensis</i> | Jiangsu: Xuyi Co., Xu Chen Zheng | 28 Jul 2005 | 2M, 1L | 33.01 | N | 118.49 | W | FC | |
| <i>sinensis</i> | Jiangsu: Xuzhou | Jul 1960; 19 Jul 1970 | 1M; 6F | 34.27 | N | 117.19 | W | IM | |
| <i>sinensis</i> | Jianxi: Nanchang | 1 May 1955 | 1F | 28.68 | N | 115.88 | W | IM | |
| <i>sinensis</i> | Jilin: Baicheng | 9 Jul 1958 | 5F | 45.62 | N | 122.82 | W | IM | |
| <i>sinensis</i> | Liaoning: Faku | No date | 1F | 42.50 | N | 123.41 | W | CA | |
| <i>sinensis</i> | Liaoning: Shenyang | No date | 1F | 41.79 | N | 123.43 | W | CA | |
| <i>sinensis</i> | Ningxia: Yinchuan | 2-25 Aug, 2 Sep 1972 | 7F | 38.47 | N | 106.27 | W | IM | |
| <i>sinensis</i> | Ningxia: Zhongwei | 8 Aug 1972 | 1F | 37.52 | N | 105.18 | W | IM | |
| <i>sinensis</i> | Shaanxi: Danfeng | No date | 2F | 33.75 | N | 110.30 | W | CA | |
| <i>sinensis</i> | Shaanxi: Danfeng Co., Qinling Mt. | 20 Aug 1996 | 4F, 1M | 33.75 | N | 110.30 | W | SM | |
| <i>sinensis</i> | Shaanxi: Nichuan Co. | No date | 2F, 1M | 34.14 | N | 107.30 | W | SM | |
| <i>sinensis</i> | Shandong: Changs- han | 9 Jun 1960 | 1F | 36.88 | N | 117.83 | W | IM | |
| <i>sinensis</i> | Shandong: Fangzi | 16 Jun 1960 | 1F | 36.60 | N | 119.15 | W | IM | |
| <i>sinensis</i> | Shandong: Haiyang | 11 Jul 1960 | 1F | 36.78 | N | 121.16 | W | IM | |
| <i>sinensis</i> | Shandong: Jiaonan | 20 Aug 1960 | 1F, 1M | 35.88 | N | 119.98 | W | IM | |

To be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|----------------------|----------------------------|---------------------------|-------------------------------|-------------------------------|-----------|--------|---|----|-------------------------|
| | | | | Latitude | Longitude | | | | |
| <i>sinensis</i> | Shandong: Jinan | 23 Jun 1960 | 1F | 36.67 | N | 117.00 | W | IM | |
| <i>sinensis</i> | Shandong: Jining | No date | 1F | 35.41 | N | 116.58 | W | CA | |
| <i>sinensis</i> | Shandong: Linyi | 1 Aug 1960; Aug 2001 | 1F | 35.06 | N | 118.34 | W | IM | |
| <i>sinensis</i> | Shandong: Nanyang | 23 Jun 1960 | 1F | 35.09 | N | 116.67 | W | IM | |
| <i>sinensis</i> | Shandong: Pingdu | 23 Aug 1960 | 1F | 36.78 | N | 119.95 | W | IM | |
| <i>sinensis</i> | Shandong: Qiaoshan- wei | 27 Aug 1960 | 2F | 36.25 | N | 116.77 | W | IM | |
| <i>sinensis</i> | Shandong: Qingdao | 30 Aug 1960 | 1M | 36.10 | N | 120.37 | W | IM | |
| <i>sinensis</i> | Shandong: Rizhao | Jul 1960 | 1M | 35.43 | N | 119.46 | W | IM | |
| <i>sinensis</i> | Shandong: Weifang | 30 Jul 1960 | 1F | 36.71 | N | 119.10 | W | IM | |
| <i>sinensis</i> | Shandong: Wendeng | 16 Jul 1960 | 1F | 37.19 | N | 122.05 | W | IM | |
| <i>sinensis</i> | Shandong: Yantai | 2, 22 Aug 1960 | 2F | 37.53 | N | 121.40 | W | IM | |
| <i>sinensis</i> | Shandong: Yidu | 13, 18 Aug 1960 | 2F | 36.70 | N | 118.48 | W | IM | |
| <i>sinensis</i> | Shanghai | 8 Aug 1988 | 2F, 1M | 31.11 | N | 121.37 | W | SM | |
| <i>sinensis</i> | Sichuan: Dukou | 20, 24-26 Jun 1975 | 1M, 3F | 26.55 | N | 101.73 | W | IM | |
| <i>sinensis</i> | Sichuan: Emei | 16 Jul 1975 | 2F | 29.58 | N | 103.52 | W | IM | |
| <i>sinensis</i> | Sichuan: Ershan | 22, 23 Jul 1975 | 2F | 32.59 | N | 103.05 | W | IM | |
| <i>sinensis</i> | Sichuan: Hongya | 8 Aug 1975 | 1F | 29.93 | N | 103.42 | W | IM | |
| <i>sinensis</i> | Sichuan: Huidong | No date | 1F | 26.65 | N | 102.58 | W | CA | |
| <i>sinensis</i> | Sichuan: Huili | 4 Jul 1975 | 1F | 26.68 | N | 102.25 | W | IM | |
| <i>sinensis</i> | Sichuan: Jiajiang | 15 Jul, 15 Aug 1975 | 5F | 29.75 | N | 103.58 | W | IM | |
| <i>sinensis</i> | Sichuan: Linan | Aug 1961 | 1F | 30.97 | N | 107.07 | W | IM | |
| <i>sinensis</i> | Sichuan: Meigu | 13, 14 Jul 1975 | 5F, 2M | 28.33 | N | 103.13 | W | IM | |
| <i>sinensis</i> | Sichuan: Mingshan | 30 Jul 1975 | 1F | 30.13 | N | 103.17 | W | IM | |
| <i>sinensis</i> | Sichuan: Miyi | 25, 29 Jun 1975 | 2F, 1M | 26.83 | N | 102.05 | W | IM | |
| <i>sinensis</i> | Sichuan: Ningnan | 18 Jun 1975 | 2F | 27.07 | N | 102.76 | W | IM | |
| <i>sinensis</i> | Sichuan: Pixian | No date | 1F | 30.80 | N | 103.88 | W | CA | |
| <i>sinensis</i> | Sichuan: Pujiang | Jul 1997 | 1F | 30.20 | N | 103.50 | W | CA | |
| <i>sinensis</i> | Sichuan: Xichang | 13-18 Jun 1975 | 3F, 3M | 27.90 | N | 102.27 | W | IM | |
| <i>sinensis</i> | Sichuan: Yaan | 28, 29 Jul, 6 Aug 1975 | 2F | 29.98 | N | 103.08 | W | IM | |
| <i>sinensis</i> | Sichuan: Zhaomian | 14 Jul 1975 | 2M | 31.58 | N | 105.43 | W | IM | |
| <i>sinensis</i> | Xinjiang: Yili | No date | 1F | 43.52 | N | 83.30 | W | CA | |
| <i>sinensis</i> | Yunnan: Gejiu | 4 Aug 1990 | 3 F | 23.37 | N | 103.16 | W | CA | |
| <i>sinensis</i> | Yunnan: Jiangchengxian | 1 Aug 1990 | 1 F | 26.47 | N | 99.87 | W | CA | |
| <i>sinensis</i> | Yunnan: Kaiyuan | No date | 1F | 23.71 | N | 103.25 | W | CA | |
| <i>sinensis</i> | Yunnan: Kunming | No date | 1F | 25.04 | N | 102.72 | W | CA | |
| <i>sinensis</i> | Yunnan: Kunming, Jungli | 10 Aug 2005 | 11F, 7M | 25.04 | N | 102.72 | W | FC | |

To be continued.

TABLE 1. (continued)

| Anopheles Species | Province: Locality | Collection date | No. and stage ¹ | Grid Coordinates ² | | | | | Repository ³ |
|----------------------|------------------------------|------------------------------------|-------------------------------|-------------------------------|-----------|--------|----|----|-------------------------|
| | | | | Latitude | Longitude | W | FC | | |
| <i>sinensis</i> | Yunnan: Kunming, Majungli | 10 Aug 2005 | 2F, 1PE | 25.04 | N | 102.72 | W | FC | |
| <i>sinensis</i> | Yunnan: Luchunxian | 9 Aug 1990 | 2 F | 23.32 | N | 102.17 | W | CA | |
| <i>sinensis</i> | Yunnan: Mengla | 16 Sep 1990 | 5 F | 21.47 | N | 101.58 | W | CA | |
| <i>sinensis</i> | Yunnan: Mengla | 2 Jul 1976 | 5F, 1M | 21.47 | N | 101.58 | W | IM | |
| <i>sinensis</i> | Yunnan: Simao | 15 Aug 1986 | 4 F | 22.77 | N | 101.08 | W | CA | |
| <i>sinensis</i> | Yunnan: Simao | 2 Jul 1976; May 1997 | 5F | 22.77 | N | 101.08 | W | IM | |
| <i>sinensis</i> | Yunnan: Wenshan- zhen | No date | 1F | 23.37 | N | 104.23 | W | CA | |
| <i>sinensis</i> | Yunnan: Yuanyangx- ian | 7 Aug 1990 | 3 F | 23.22 | N | 102.68 | W | CA | |
| <i>sinensis</i> | Zhejiang: Dinghai | 22 Aug, 3 Sep 1954 | 2F | 30.02 | N | 122.10 | W | IM | |
| <i>sinensis</i> | Zhejiang: Hangzhou | 13 Jul 1960 | 5 F | 30.26 | N | 120.17 | W | CA | |
| <i>sinensis</i> | Zhejiang: Huangyan | 30 Jun, 30 Sep 1955 | 3F | 27.75 | N | 119.99 | W | IM | |
| <i>sinensis</i> | Zhejiang: Huzhou | Jun 1956 | 1F | 30.87 | N | 120.10 | W | IM | |
| <i>sinensis</i> | Zhejiang: Linan | Aug 1968; 11 Jul 1978; May 2000 | 5F, 1M; 3F | 30.24 | N | 119.72 | W | IM | |
| <i>sinensis</i> | Zhejiang: Moganshan | 4-6 Jul 1978 | 6F | 30.60 | N | 119.87 | W | IM | |
| <i>sinensis</i> | Zhejiang: Tianmu- shan | 1, 4, 20, 29 Jul 1978 | 4F | 30.30 | N | 119.39 | W | IM | |
| <i>sineroides</i> | Jilin: Jian | 23 Oct 1952 | 1F | 41.12 | N | 126.18 | W | IM | |
| <i>sineroides</i> | Liaoning: Xiuyan | 15 Jun 1958 | 1F | 40.29 | N | 123.27 | W | IM | |
| <i>sineroides</i> | Liaoning: Xiuyan | 14 Jul 1958 | 1F | 40.29 | N | 123.27 | W | IM | |
| <i>sineroides</i> | Liaoning: Xiuyan | 23 Sep 1958 | 1F | 40.29 | N | 123.27 | W | IM | |
| <i>sineroides</i> | Liaoning: Zhuanghe | 14 Jul 1958 | 1F | 39.70 | N | 122.99 | W | IM | |
| <i>sineroides</i> | Liaoning: Zhuanghe | 26 Aug 1973 | 4F, 2M | 39.70 | N | 122.99 | W | IM | |

¹F, adult female; Ge, male genitalia; L, whole larva; Le, larval exuviae; M, adult male; P, whole pupa; Pe, pupal exuviae; D, DNA material.

²Coordinates expressed as degrees and decimals of degrees.

³CA = Entomology Museum, Chinese Academy of Sciences (Institute of Zoology), Beijing;

FC = Field collected, deposited in Smithsonian Institution (Natural History Museum), Washington, D. C.;

IM = Entomology Museum, Beijing Institute of Microbiology and Epidemiology, Beijing;

SM = Entomology Collection, Second Military Medical Univ. (Department of Etiologic Biology), Shanghai.

Anopheles belenrae was originally reported from South Korea (Rueda 2005; Rueda *et al.* 2006). Based on morphological examinations of specimens and rDNA-ITS2 sequence comparisons, we determined that *An. belenrae* is the same as *An. unknown "sp. 2"* of Ma & Xu (2005). The status of *An. belenrae* as a malaria vector in China is unknown. Ma & Xu (2005) also reported *An. unknown "sp. 1"* (collection data: 3 females, from Rongcheng, Shandong, June 1991; GenBank accession number AY 306128; deposited at the Entomology Collection, Department of Etiologic Biology, Second Military Medical University, Shanghai). The true identity of this species is not yet determined and additional specimens are needed for further morphological and molecular analysis.

TABLE 2. *Anopheles* Hyrcanus Group species previously recorded and observed from 24 provinces and 2 cities of China.

| Anopheles Species | Province (Reference) |
|---|---|
| <i>argyropus</i> | 25*(P3)** |
| <i>belenrae</i> | 17(P2, X), 20 (P2, X)*** |
| <i>changfus</i> | 23(P6) |
| <i>crawfordi</i> | 25(P2) |
| <i>dazhaius</i> | 23(X) |
| <i>hailarensis</i> | 18(P5) |
| <i>heiheensis</i> | 10(P3, P6, P7) |
| <i>hyrcanus</i> | 24(P2, P4, X) |
| <i>junlianensis</i> | 23(P2, P7) |
| <i>kiangsuensis</i> | 14(P3) |
| <i>kunningensis</i> | 23(X), 25(P2, X) |
| <i>kweiyangensis</i> | 1(P3, P4), 3(P3, P4), 6(P3, P4), 7(P4, X), 11(P4, X), 12(P3, P4), 13(P3, P4), 17(X), 23(P2, P4, X), 25(P4), 26(X) |
| <i>lesteri</i> (= <i>anthropophagus</i>) | 1(P3), 3(P4), 5(P3, P4, X), 6(P2, P4), 7(P3, P4), 8(P2, P4), 11(P2, P4), 12(P4), 13(P3, P4), 14(P4, X), 15(P4), 17 (P2), 23(P4), 25(P3, P4), 26(P4) |
| <i>liangshanensis</i> | 23(P2, P4, X), 25(P4, X) |
| <i>nigerrimus</i> | 3(P3, P4), 6(P3, P4), 7(P3, P4), 15(P3, P4), 25(P3, P4) |
| <i>nitidus</i> | 6(P3) |
| <i>peditaeniatus</i> | 3(P4, X), 6(P4, X), 7(P3), 8(P4, X), 25(P2, P4, X) |
| <i>pullus</i> | 7(P4, X), 9(P3, P4), 10 (P4, P7, X), 11(P2, P4), 14(P3, P4), 16(P3, P4), 17(P2, P4, X), 18(P3, P4), 20(P4, X), 22(P3, P4), 23(P2, P4, X), 25(P3, P4) |
| <i>sinensis</i> | 1 (P1, X), 2(P1, X), 3(P1), 4(X), 5(P1, X), 6(P1, X), 7(P1, X), 8(P1, X), 10 (P1, X), 11(P1, P2, X), 12(X), 14(P1, P2, X), 15(X), 16(X), 17(P1), 19(X), 20(P1, P2, X), 21(X), 22(P1, X), 23(P1, P2, X), 24(P1, X), 25(P1, P2, X), 26(P1, P2, X) |
| <i>sineroides</i> | 16(X), 17(X) |
| <i>xiaokuanus</i> | 10(P6) |

*Provinces: 1 = Anhui; 2 = Beijing; 3 = Fujian; 4 = Gansu; 5 = Guandong; 6 = Guangxi; 7 = Guizhou; 8 = Hainan; 9 = Hebei; 10 = Heilongjiang; 11 = Henan; 12 = Hubei; 13 = Hunan; 14 = Jiangsu; 15 = Jiangxi; 16 = Jilin; 17 = Liaoning; 18 = Inner Mongol; 19 = Ningxia; 20 = Shandong; 21 = Shanghai; 22 = Shaanxi; 23 = Sichuan; 24 = Xinjiang; 25 = Yunnan; 26 = Zhejiang.

**References: P1 = Rueda et al (2005); P2 = Ma and Xu (2004); P3 = Lu et al (1997); P4 = Lu and Yong (2003); P5 = Xu and Luo (1998); P6 = Ma (1981); P7 = Lei (1996); P8 = Ma and Yu (1993); X = observed in this survey.

***Listed as *Anopheles* unknown "sp. 2" by Ma and Xu (2005).

In this paper, we followed Harbach (2004) and Ma & Xu (2005) for the list of known species, except for inclusion of a few species (i.e., *An. dazhaius*, *kiangsuensis*, and *xiaokuanus*) for which further studies are needed to resolve their taxonomic validity. A list of the Hyrcanus group, with valid species and their synonyms is also found in the mosquito catalog at the Walter Reed Biosystematics Unit website (<http://www.mosquitocatalog.org/main.asp>). Ma & Xu (2005) reported 12 species of the group in China, with their synonyms, based on the sequences of the second internal transcribed spacer (ITS2) of ribosomal DNA. Wilkerson et al. (2003), Rueda et al. (2005b) and Ma & Xu (2005) considered *An. anthropophagus* to be a junior synonym of *An. lesteri*. Harbach (2004) agreed and excluded *An. anthropophagus* from his list of valid Hyrcanus group species. Rueda et al. (2005b) designated and described the neotype of *An. lesteri* from the new type

locality (Calauan, Laguna, Philippines) to clarify and stabilize the taxon. This new type locality is where the "cotypes" of the original *lesteri* were collected in 1936 (Baisas and Hu 1936). As stated in the International Code of Zoological Nomenclature (ICZN 1999), Article 76.3, page 87, the place of origin of the neotype becomes the type locality of the species-group taxon, despite any previously published statement of the type locality. Rueda *et al.* (2005b) provided detailed descriptions and illustrations of the *An. lesteri* neotype and associated specimens, particularly the larval and pupal stages, adult female and male genitalia, as well as the rDNA ITS2 sequence (GenBank accession number AY375469).

Anopheles kunmingensis may be a synonym of *An. liangshanensis* based on rDNA ITS2 sequence, morphological comparisons (Ma *et al.* 2000) and on cross-hybridization experiments (Kang *et al.* 1992). However, Ma & Xu (2005) reconsidered these two species as valid. The type localities of *An. kunmingensis* and *An. liangshanensis* are in the provinces of Yunnan and Sichuan, respectively. Our examination of collection data from museum specimens revealed that *An. kunmingensis* and *An. liangshanensis* occur in both provinces. Although they have distinct morphological features, extreme care must be taken in selecting specimens as DNA sources for sequence analysis. It is not uncommon to find misidentified specimens with their sequences reported. Until further studies can help resolve these uncertainties, we consider both *An. kunmingensis* and *An. liangshanensis* to be valid species.

We also attempted to check the status of the type specimens of 11 species of the Hyrcanus group originally collected from China. Yang *et al.* (1991) reported that the holotypes, allotypes, and paratypes of four species (*An. changfus*, *An. dazhaius*, *An. heiheensis*, *An. xiaokuanus*) are in the Institute of Zoology, Chinese Academy of Science, Beijing but they could not be located (Rueda *et al.* 2005a). In 2005, LMR visited the type localities of *An. kunmingensis* in Kunming, Yunnan and *An. kweiyangensis* in Guiyang, Guizhou but failed to collect specimens of those species. Additional collections by LMR in 2005 from near the type localities of *An. kiangsuensis* and *An. liangshanensis* in the provinces of Jiangsu and Sichuan, respectively, failed to yield specimens of either species. The location of the type specimens of *An. kweiyangensis* is unknown, and further inquiries failed to locate the types of the remaining species from reported depositories.

Because of the absence of type specimens, it is extremely difficult to determine the validity of some Hyrcanus group species. There is an urgent need to recover the missing type specimens, or if not possible, to replace them (e.g. with neotypes) in order to stabilize the whole group. Type specimens (or associated specimens) could be used for both molecular and morphological comparisons of questionable species. These may help to solve the taxonomic problems and other identification challenges of the group.

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